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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/759,592

01/16/2004

Jie Liu

180/167/2

8701

22428 7590 02/21/2008

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EXAMINER

MILLER, DANIEL H

ART UNIT

PAPER NUMBER

1794

MAIL DATE

DELIVERY MODE

02/21/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/759,592	Applicant(s) LIU ET AL.	
	Examiner DANIEL MILLER	Art Unit 1794	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 December 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 69-71, 73-80, 82 and 89-92 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 69-71, 73-80, 82 and 89-92 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 69-71, 73-80, 82, 89-92 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. No where in the specification does applicant indicate that a method for growing nanotubes to an n infinite length. Applicant is not enabled for any length SWCNT greater than 1mm. For example, there is no indication that applicant has enabled one of ordinary skill to produce a SWCNT 1-foot long, a yard, or a mile long, etc.

3. A number of factors must be considered in assessing the enablement of an invention, including the following: the breadth of the claims, the amount of experimentation necessary, the guidance provided in the specification, working examples provided, predictability, and the state of the art. See *In re Wands*, 858 F.2d 731, 8 USPQ2nd 1400 (Fed. Circ. 1988).

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4. It is clear from the state of the art that the growth of SWCNT's individually to extremely long lengths (several feet or yards) is not readily obtainable because of the turbulence inherent in the growth process will often break the nanotube before it can grow to such lengths. There are no examples in the specification that would help to solve the various technological barriers to extremely long individual SWCNT growth (say 10 feet long). One of ordinary skill would not predict to be able to use applicant's method to grow infinitely long nanotubes nor is it clear that any level of experimentation would allow one of ordinary skill to accomplish infinitely long nanotube growth. Applicant's specification is therefore not enabled for the claimed range of greater than 1mm.

5. Correction required.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 69-71, 73-75, and 77-80, 82, 89-92 are rejected under 35 U.S.C. 102(b) as being anticipated by Zhu (Science 3 May 2003 Vol. 296).

3. Li US 7,157,068 cited for evidentiary purposes.

4. Zhu teaches the growth of well-aligned single and multi walled carbon nanotubes grown to lengths of 10 or 20 centimeters (page 84 and fig. 1).

5. The claim language “a carbon nanotube synthesized on a substrate” of claim 69 does not positively recite a substrate and is considered a product by process limitation.

6. “[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.”, (In re Thorpe, 227 USPQ 964,966). Once the Examiner provides a rationale tending to show that the claimed product appears to be the same or similar to that of the prior art, although produced by a different process, the burden shifts to applicant to come forward with evidence establishing an unobvious difference between the claimed product and the prior art product (In re Marosi, 710 F.2d 798, 802, 218 USPQ 289, 292 (Fed. Cir. 1983), MPEP 2113)

7. Regarding claim 73, the recited process steps regarding the method of making the nanotube do not appear to patentably distinguish the claimed product over that disclosed in the prior art. The claims are directed to a product, where the method of making the product would not be expected to significantly affect the material properties of the resultant product, per se, absent any clear and convincing evidence and/or arguments to the contrary. Therefore, the claim is anticipated.

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8. Further, the claimed invention does not define over the prior art. It is well known in the art that nanotubes can grow out of the open ends of other nanotubes or out of side wall defects (sometimes referred to as Y branching; see Li US 7,157,068). This growth phenomenon would inherently provide an "individual" nanotube as claimed with longer nanotubes being formed. In the case of Zhu they would be expected to form along the 10 to 20 cm long nanotube strands. No distinction over the prior art and the claimed invention is seen.

9. Regarding claim 75, it can be seen from figure 1 of page 84 that the two SWNT's are substantially isolated from one another.

10. Regarding claim 77, Zhu teaches SWCNT's containing 5wt% (a metal) Fe catalyst impurities; which could function as an electrode.

11. Regarding claims 78-80, and 82, it is noted that the term device is not defined in the specification. Therefore, for purposes of examination any article is considered to meet the limitation "device". The SWCNT bundles have a few individual nanotubes protruding from the edges (page 84 third column). These nanotubes are capable of being used for their physical or electrical properties and therefore meet the limitation of a "device".

12. Regarding claims 89-92, the nanotubes are depicted on a substrate (figure 1), and are considered to be "supported" as claimed. The nanotubes would inherently have a nanoparticle on one end from the growth process.

13. Where, as here, the reference discloses all the limitations of a claim except a property or function, and the examiner cannot determine whether or not the reference

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inherently possesses properties which anticipate or render obvious the claimed invention, the burden of proof is shifted to the applicant, as in *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980). It is noted that the process steps claimed in a product by process claim are considered only insofar as they affect the structure of the claimed product.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. Claims 69-71 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley et al. (US 6,749,827).

16. Li US 7,157,068 cited for evidentiary purposes.

17. Smalley et al. teaches a process for the growth of single-walled carbon nanotubes and macroscopic fibers comprising single-walled carbon nanotube arrays to any desired length (col.12, lines 8-22 and col. 23, lines 17-29). The lengths may range from nanometers up to meters (col. 28, lines 37-51). The fibers are grown or elongated using single-walled nanotube arrays as templates, whereby the diameter of the fiber may be controlled as well.

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18. The reference demonstrates a desired push in the art to grow longer continuous carbon nanotubes that are needed for particular applications.

19. It would have been obvious to one of ordinary skill at the time of invention to grow the nanotube fibers, or strands, of Smalley to a length within the claimed ranges in order to suit a desired use, such as field effect transistors or biological sensor applications which require longer length nanotubes. One of ordinary skill would recognize that increase in processing time would (due to growth rates of the nanotubes) yield longer nanotubes. No patentable distinction is seen.

20. Further, the claimed invention does not define over the prior art. It is well known in the art that nanotubes can grow out of the open ends of other nanotubes or out of side wall defects (sometimes referred to as Y branching; see Li US 7,157,068). This growth phenomenon would inherently provide an "individual" nanotube as claimed with longer branched nanotubes being formed. In the case of Smalley one of ordinary skill would expect that with increased growth time would inherently produce longer nanotubes as claimed. No patentable distinction over the prior art and the claimed invention is seen.

21. Due to the diameters of single-walled nanotubes (about 1-2 nm) the aspect ratio of the nanotube strands of Smalley et al. are seen to be greater than 10^8 . The resistivity, electrical behavior, and Young's modulus of the strands and nanotubes are not specifically taught, however they are expected to be within the claimed ranges as no difference is seen between the product of Smalley et al. and that of the instantly claimed invention.

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22. Where, as here, the claimed and prior art products are identical or substantially identical, or are produced by identical or substantially identical processes, the burden of proof is shifted to the applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of his claimed product. See *In re Best*, 195 USPQ 430.

23. Where, as here, the reference discloses all the limitations of a claim except a property or function, and the examiner cannot determine whether or not the reference inherently possesses properties which anticipate or render obvious the claimed invention, the burden of proof is shifted to the applicant, as in *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980). It is noted that the process steps claimed in a product by process claim are considered only insofar as they affect the structure of the claimed product.

24. Claims 69-71, 73-75, 77-80, 82, 89-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim (synthesis of ultralong and high percentage of semi-conducting single walled carbon nanotubes; Nano Letters 2002 Vol. 2 No. 7 703-708).

25. Kim teaches SWNTs grown from patterned Fe₂O₃ nanoparticles wherein isolated nanotubes are grown with lengths > 100 micrometers and observed lengths as long as 600 micrometers.

26. The claim language “a carbon nanotube synthesized on a substrate” of claim 69 does not positively recite a substrate and is considered a product by process limitation.

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27. “[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.”, (In re Thorpe, 227 USPQ 964,966). Once the Examiner provides a rationale tending to show that the claimed product appears to be the same or similar to that of the prior art, although produced by a different process, the burden shifts to applicant to come forward with evidence establishing an unobvious difference between the claimed product and the prior art product (In re Marosi, 710 F.2d 798, 802, 218 USPQ 289, 292 (Fed. Cir. 1983), MPEP 2113).

28. Regarding claim 79, Kim teaches the nanotubes can be exploited to for building large numbers of FETs (Field Effect Transistors) or sensors along their lengths (pg. 707).

29. Regarding claim 73, it is not clear that the process steps claim define the invention structurally. Therefore, the claim is anticipated.

30. Regarding claim 72, the nanotubes are smooth and continuous.

31. Regarding claim 75, the SWNT's are substantially isolated from one another.

32. Regarding claim 77, the SWCNT's inherently containing metal Fe catalyst impurities present from fabrication; which could function as an electrode. In the alternative, Kim teaches the nanotubes can be exploited to for building large numbers of FETs (Field Effect Transistors) or sensors along their lengths (pg. 707).

33. Regarding claims 78-83, it is noted that the term device is not defined in the specification. Therefore, for purposes of examination any article is considered to meet the limitation "device". Kim teaches the nanotubes can be exploited to for building large numbers of FETs or sensors along their lengths (pg. 707). Since the nanotubes are capable of being used for their physical or electrical properties and therefore meet the limitation of a "device".

34. The reference demonstrates a desired push in the art to grow longer continuous carbon nanotubes that are needed for particular applications.

35. It would have been obvious to one of ordinary skill at the time of invention to grow the nanotube fibers, or strands, of Kim to a length and diameter within the claimed ranges in order to suit a desired use, such as field effect transistors or biological sensor applications which require longer length nanotubes. One of ordinary skill would recognize that increase in processing time would (due to growth rates of the nanotubes) yield longer nanotubes. No patentable distinction is seen.

36. Claims 73 and 76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhu (Science 3 May 2003 Vol. 296) or Kim or Smalley in view of Lieber et al (US 6,781,166 B2).

37. Zhu or Kim or Smalley, discussed above, are silent as to the nanotubes being in a crossed networked array.

38. Lieber teaches an electrical device having a cross networked array of nanotubes grown from catalytic particles on a substrate (figure 1 and abstract).

39. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Zhu or Kim by growing the nanotubes from a catalytic particle on a substrate and achieving a cross networked geometry as in Lieber in order to take advantage of the electrical properties of the nanotubes in Zhu or Kim; using them in an electrical switch (i.e. memory device; see figure 5 Lieber) substantially similar to Lieber.

Response to Arguments

40. Applicant's arguments filed 12/5/2007 have been fully considered but they are not persuasive.

41. The original 112 rejection and objection to the claims have been withdrawn. However, a new 112 rejection has been asserted (see above).

42. Applicant's 132 affidavits submitted by Richard Czerw, has been carefully considered and is noted to be very helpful in defining the disclosed invention. However, the affidavit only states, that the Zhu reference "probably" does not achieve the desired growth length (top of page 4). While some suggestive argument is provided no evidence has been provided to demonstrate that the Zhu reference and applicant's claimed invention are not inherently the same. It is noted that applicant has not claimed a young's modulus or any related properties.

43. Where, as here, the reference discloses all the limitations of a claim except a property or function, and the examiner cannot determine whether or not the reference

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inherently possesses properties which anticipate or render obvious the claimed invention, the burden of proof is shifted to the applicant, as in *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980). It is noted that the process steps claimed in a product by process claim are considered only insofar as they affect the structure of the claimed product.

44. Further, the claimed invention does not define over the prior art. It is well known in the art that nanotubes can grow out of the open ends of other nanotubes or out of side wall defects (sometimes referred to as Y branching; see Li US 7,157,068). This growth phenomenon would inherently provide an "individual" nanotube as claimed with longer nanotubes being formed. In the case of Kim they would be expected to form along the 10 to 20 cm long nanotube strands. No distinction over the prior art and the claimed invention is seen.

45. New rejections have also been asserted over Smalley and Kim (see above).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL MILLER whose telephone number is (571)272-1534. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Keith Hendricks can be reached on (571)272-1401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Daniel Miller

/KEITH D. HENDRICKS/

Supervisory Patent Examiner, Art Unit 1761